

IN THE CLAIMS:

1. (Original) A method for detecting registering errors for multi-color rotary presses which comprises steps of

printing one or more register marks on a paper web in each printing section,

causing a light source to flash based on a reference signal output by signal output means

5 that operates in synchronism with the rotation of a predetermined reference plate cylinder and issues signals,

causing reading means that operates in synchronism with the flashing of the light source to read the register marks printed by all the printing sections, developing the register marks into matrix data, and finding a first center of gravity from the matrix data as an approximate center
10 of gravity of each register mark,

using the first center of gravity as a basis point to find a second center of gravity as a high-precision center of gravity of each register mark,

using the second center of gravity of a predetermined register mark as a reference to find the relative position of the second center of gravity of any other register mark, finding
15 deviations of the found relative positions from a predetermined reference relative position, and regarding the deviation as a registering error.

2. (Original) A method for detecting registering errors for multi-color rotary presses as set forth in Claim 1 wherein a process of reading the register marks printed by all the plate cylinders, developing the read register marks into matrix data, and finding a first center of

gravity of each register mark from the matrix data is repeated a predetermined number of times,
5 and the average coordinate value of the predetermined number of first center of gravity as the
final first center of gravity coordinate value.

3. (Currently Amended) A method for detecting registering errors for multi-color rotary
presses as set forth in Claim 1 ~~or 2~~, wherein the register marks are of a single and point-
symmetrical figure, a first center of gravity of each register mark is found as an approximate
center of gravity thereof from the matrix data prepared by developing the read register marks,
5 and a second center of gravity is found as a high-precision center of gravity from the first center
of gravity.

4. (Currently Amended) A method for detecting registering errors for multi-color rotary
presses as set forth in Claim 1 ~~or 2~~, wherein the register marks are of a single and point-
symmetrical figure having at least two lines of symmetry, two virtual x-y coordinate systems
having the two axial symmetry lines of the register marks as the y-axis are set, the matrix data
5 is scanned for each virtual x-y coordinate system in increments of a predetermined pitch along
the y axis in the direction vertical to the y axis, lines parallel to the y-axis and having as the x
coordinate value the x coordinate average value of the length centers between the resulting
matrix-data outer edge length centers are found, and the intersection of the two straight lines
is regarded as a first center of gravity.

5. (Currently Amended) A method for detecting registering errors for multi-color rotary presses as set forth in Claim 3 ~~or 4~~, wherein a line segment produced when the straight line passing the first center of gravity intersects with the outer edge of the matrix data at two points is divided by the first center of gravity into two line segments, the length half the difference in length between the two line segments is regarded as a center of gravity deviation, a point on a longer line segment among the two line segments separated from the first center of gravity by a length equal to the center of gravity deviation is regarded as a center of gravity deviation point, find the center of gravity deviation point in a plurality of directions, and the center of gravity deviation point that is remotest from the first center of gravity among the resulting center of gravity deviation points is regarded as a second center of gravity.

6. (Original) A method for detecting registering errors for multi-color rotary presses as set forth in Claim 5 wherein the average coordinate value of the center of gravity points is regarded as a second center of gravity coordinate value.

7. (Original) An apparatus for detecting registering errors for multi-color rotary presses comprising

signal output means operating in synchronism with the rotation of a predetermined plate cylinder for outputting a reference signal,

a sensor for detecting the reference position of the rotating reference plate cylinder to output a reference position signal,

a light source provided in the vicinity of a paper web for illuminating a plurality of register marks printed on the paper web by separate printing section,

10 a light emission timing section for outputting a light emission timing signal based on the reference signal and the reference position signal,

reading means provided facing the traveling paper web for reading the register marks to fetch as two-dimensional image data,

an image data processing section for digitizing the two-dimensional image data into pixel matrix data for storage into a memory,

15 a first center of gravity calculating section for finding a first center of gravity as an appropriate center of gravity from the matrix data of each register mark,

a second center of gravity for finding a second center of gravity as a high-precision center of gravity based on the first center of gravity from the matrix data of each register mark, and

20 deviation calculating means for using as a reference the second center of gravity of a predetermined register mark to find the relative positions of other register marks, and finding a deviation of the obtained relative positions from a predetermined reference position.

8. (Original) An apparatus for detecting registering errors for multi-color rotary presses as set forth in Claim 7 wherein the first center of gravity calculating section and the second center of gravity calculating section are combined into a single calculating section.

9. (Original) An automatic register control apparatus for multi-color rotary presses comprising

signal output means operating in synchronism with the rotation of a predetermined plate cylinder for outputting a reference signal,

5 a sensor for detecting the reference position of the rotating reference plate cylinder to output a reference position signal,

a light source provided in the vicinity of a paper web for illuminating a plurality of register marks printed on the paper web by separate printing section,

10 a light emission timing section for outputting a light emission timing signal based on the reference signal and the reference position signal,

reading means provided facing the traveling paper web for reading the register marks to fetch as two-dimensional image data,

an image data processing section for digitizing the two-dimensional image data into pixel matrix data for storage into a memory,

15 a first center of gravity calculating section for finding a first center of gravity as an appropriate center of gravity from the matrix data of each register mark,

a second center of gravity for finding a second center of gravity as a high-precision center of gravity based on the first center of gravity from the matrix data of each register mark,

20 deviation calculating means for using as a reference the second center of gravity of a predetermined register mark to find the relative positions of other register marks, and finding a deviation of the obtained relative positions from a predetermined reference position,

a control signal output section for converting the resulting deviation value into a plate cylinder phase control signal, and

plate cylinder phase control means for controlling plate cylinder phase based on the phase control signal.

10. (Original) An automatic register control apparatus for multi-color rotary presses as set forth in Claim 9 wherein the first center of gravity calculating section and the second center of gravity calculating section are combined into a single calculating section.

11. (New) A method for detecting registering errors for multi-color rotary presses as set forth in Claim 2, wherein the register marks are of a single and point- symmetrical figure, a first center of gravity of each register mark is found as an approximate center of gravity thereof from the matrix data prepared by developing the read register marks, and a second center of gravity is found as a high-precision center of gravity from the first center of gravity.

12. (New) A method for detecting registering errors for multi-color rotary presses as set forth in Claim 2, wherein the register marks are of a single and point- symmetrical figure having at least two lines of symmetry, two virtual x-y coordinate systems having the two axial symmetry lines of the register marks as the y-axis are set, the matrix data is scanned for each virtual x-y coordinate system in increments of a predetermined pitch along the y axis in the direction vertical to the y axis, lines parallel to the y-axis and having as the x coordinate value

the x coordinate average value of the length centers between the resulting matrix-data outer edge length centers are found, and the intersection of the two straight lines is regarded as a first center of gravity.

13. (New) A method for detecting registering errors for multi-color rotary presses as set forth in Claim 4, wherein a line segment produced when the straight line passing the first center of gravity intersects with the outer edge of the matrix data at two points is divided by the first center of gravity into two line segments, the length half the difference in length between the two line segments is regarded as a center of gravity deviation, a point on a longer line segment among the two line segments separated from the first center of gravity by a length equal to the center of gravity deviation is regarded as a center of gravity deviation point, find the center of gravity deviation point in a plurality of directions, and the center of gravity deviation point that is remotest from the first center of gravity among the resulting center of gravity deviation points is regarded as a second center of gravity.